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CRITICAL VALUES FOR THE LIGHT MINIMUM AND FOR THE AMOUNT AND RAPIDITY OF DARK ADAPTATION

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THE retinal functions usually selected for the study and diagnosis of eye diseases are the light and colour sense as tested by the determination of the minimal and difference thresholds in central vision and with the perimeter and tangent screen in peripheral vision. There are other functions, however, which may also be worthy of consideration in this connection. A very important function is the changing sensitivity of the retina as a reaction to intensity of light. In the maturity and versatility of this reaction the eye is unique.

When the photographic plate is acted upon by light there is a very rapid and a permanent loss of sensitivity. When the retina is acted upon by light there is also a rapid loss of sensitivity, but the loss is much less rapid than for the photographic plate and is not permanent. When the light is shut off, the retina completely

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recovers its sensitivity unless damaging intensities have been used; but the rate of recovery is much slower than the rate of loss. Furthermore, any change in the intensity of light to which the eye is exposed is followed by an increase or decrease in sensitivity, depending upon the direction in which the change takes place. This capacity to change its sensitivity in reaction to intensity of light serves a very important purpose in the economy of vision. The sensorium functions effectively only within a certain range of intensity of excitation. When the intensity is too high, dazzle or glare results and the details in the image are confused; and when it is too low, the sensation difference between the details in the image becomes too slight to be discriminated. This adaptive function or capacity to change its sensitivity tends, therefore, to keep the retina functioning within the favourable range of excitation.

Other aspects of the excitation of the sensorium and the change in its excitability due to exposure to light are contrast and after-image. By contrast, brightness difference and certain colour differences between details in the image are accentuated in sensation. This is, of course, an important aid to their discrimination. Further, it is an important aspect of this aid that both brightness and colour contrast are increased at low illumination where the physical conditions for visibility are poor, and that colour contrast is the greatest when there is little or no brightness difference in the details of the image to serve as a basis for their discrimination.

As their name indicates, after-images of themselves play no part in the sensory picture produced by the physical image on the retina. The positive after-image, which is of very short duration with a light-adapted eye, renders an important service, however, in giving smoothness and continuity to the visual experience of successive impressions without causing a confusing and troublesome overlapping of the impressions, and perhaps reduces the time of exposure that is required for their discrimination. Another important factor in the smoothness and continuity of the visual experience is the lag in the response of the retina. That is, if sensation rose to its full value immediately on receiving the impression and died away abruptly at the cessation of the stimulation, the visual experience would be disconnected and discontinuous as the eyes shift their fixation quickly from one object to another or when for any reason visual impressions succeed each other at short intervals.

The negative after-image, coming at a later stage in the reaction and only under certain conditions of observation, is of no use at all in the act of seeing. However, it has its origin in the processes underlying the changes in sensitivity which occur as a reaction to intensity of light and is of value in experimental work and in

testing, as an index of the stage of recovery of sensitivity after the light is shut off.

It is scarcely conceivable that these more delicate and in some cases more complicated functions of the sensorium are not affected by pathological disturbances. They and other aspects of the visual response, such as the fusion of colours and of brightness and colour, the reaction to successive impressions at different rates of succession, etc., offer interesting possibilities for study in relation to diseases of the eye. Whether they can be made of service in diagnosis; however, remains yet to be determined. Success in this respect depends in very large measure on the methods that are devised for the control of the variable factors which influence the results, on the instruments which are used for applying these methods and on the predetermination of correct and suitable critical values to serve as a basis for detecting pathological disturbances and for differentiating between diseases. In carrying out our programme for the study of the diseases of the eye it is our intention to include as many of these functions as may be found to be feasible and of value for the purpose.

Of these, the processes involved in the change in sensitivity with change of intensity of light would seem to be the most obviously fundamental and important. Also their apparent similarity to the bodily processes of fatigue and recovery suggests that they may have great susceptibility to pathological disturbances. It has been our purpose in the present study to consider in relation to the light sense the slower of these two processes and, for that reason, the one more feasible for testing, namely, the changes in the sensitivity to light which occur during dark adaptation. This study has involved the determination of the light minimum immediately after a suitable length of exposure to light of a given intensity and at selected intervals after the light was shut off through a period of 20 minutes. The results of these determinations plotted in a curve present a very comprehensive picture of the power of the retina to recover from the loss of sensitivity produced by stimulation by light. Such a picture portraying not only the eye's place or ranking in a scale of sensitivities, but also its power or capacity to recover its sensitivity after fatigue, should certainly give us at a glance important information as to its health and general state of efficiency, so far as reaction to stimulation by light is concerned. The items shown in the curves are the range or total amount of recovery, the amount which occurs in each of the intervals tested, and the rapidity of recovery for each of these intervals and for the total time. The grading or ranking of a given eye with reference to these particulars obviously requires a scale, or other means showing graded distribution, in which the range and frequency of occurrence of the various levels of sensitivity and

powers of recovery are shown for a suitably sampled group of non-pathological eyes. Provided with such a scale it should not be difficult for the examiner to reach a reasonably satisfactory conclusion as to the normality of the light sense for any eye examined.

In the following paper will be given tabular results for 206 carefully selected non-pathological eyes; distribution curves which show the frequency of occurrence of the various values of light minimum at the end of the period of light adaptation and after 20 minutes of dark adaptation; curves plotted at significant points in the distribution of cases, which show the rapidity of change of the light minimum during the intervals selected for making the determinations; and as a special aid in making a diagnosis or classification, a chart which shows the median, the 95 and the 5 percentile curves. The place of these curves in the entire group may be indicated as follows: 50 per cent. of the cases gave values of light minimum equal to or better than those represented in the median curve and 50 per cent. equal to or worse; 5 per cent. gave values equal to or worse than those shown in the curve selected to represent the upper normal limit; and 5 per cent. gave values equal to or better than those shown in the curve selected to represent the lower normal limit. The 5 percentile curve (called in the chart the upper normal limit) has been chosen by us as representing values of the light minimum and course of adaptation which may be considered as suspicious or borderline between healthy and pathological eyes. By drawing the curves for any given eye on this standard chart, its relationship to the selected group of normal eyes may be readily seen. We have found these charts to be of very great value in the detection of pathological disturbances, especially in borderline and near-borderline cases when the help is most needed, and in evaluating small changes in the advance and recession of such disturbances in many ocular diseases.

Method of Working

The determinations were made with the Ferree-Rand instrument for testing the light sense and the amount and rapidity of light and dark adaptation. This instrument was devised for the control of all the factors which influence the results of the test for sensitivity to light and for making a specification by direct measurement of the amount of light entering the eye in any determination. It has been described and its features and advantages enumerated in a previous paper.*

* Ferree, C. E., Rand, G —A new type of instrument for testing the light and colour sense. *Amer. Jl. Ophthal.*, Vol. XIV, p. 325-333, 1931.

The instrument made it possible to do the work under the precise conditions of measurement and control that are needed in making standard determinations. Some of these were: (1) All variable effects due to size of pupil, accommodation, distance of projection of the image and errors of refraction were, as far as is possible, eliminated from the results; (2) the eye was presensitized to a constant state of light adaptation before each series of determinations was begun; (3) determinations of the light minimum were made with a constant degree of light adaptation and after fixed intervals of dark adaptation; (4) fixation was maintained in all cases with a very satisfactory degree of accuracy; (5) the density of light or the amount entering the eye per unit area of stimulus was measured directly and expressed in terms of lumens $\times 10^{-10}$ per sq. mm. of stimulus; and (6) a means of making an objective check on the judgment was provided.

After considerable preliminary experimentation on the effect of size and shape of stimulus on the results, an oblong stimulus subtending a visual angle of 10 degrees in the horizontal dimension and 3 degrees in the vertical was chosen as the most suitable for making the standard determinations. As an objective check on the judgment this stimulus could be rotated when desired into any position within a range of 180 degrees.

As an aid to the control of fixation, the test was always begun at an intensity at which the stimulus was visible and the observer was instructed to look at its centre. The light was then rapidly decreased until it was reported as no longer seen and then again increased to the threshold of visibility. Little or no difficulty was experienced in the control of fixation for a stimulus of this size as its edges extended into the more sensitive peripheral retina and there was in consequence no incentive for the eye to take an eccentric fixation, *i.e.*, the stimulus was most clearly seen when its centre was fixated. It can be readily understood that the use of any luminous device within the stimulus area for the control of fixation, however low the luminosity, would not have been desirable because of the effect it would have had on the value of the light minimum. It can be further understood that circumscribed devices such as we have described in a former paper* would not be effective with the size and shape of stimulus which we have found best to use in making these determinations; and that the blind spot control which we also described in that and other papers is entirely infeasible for any type of clinical work. With the size of stimulus and the method used in making the determination a very satisfactory reproducibility of result was obtained

* Ferree, C. E., Rand, G. and Stoll, M. R.—Size of stimulus in relation to the eye's sensitivity to light and to the amount and rate of dark adaptation. *Jl. Exper. Psychol.*, Vol. XVII, pp. 646-661.

for any given observer and a sufficiently narrow range of scatter in the group of observers. This is commonly accepted as the final and practical check on adequacy of control.

In order that each series of determinations should be begun with the eye in as nearly the same state of sensitivity as possible, the observer was adapted for 20 minutes in a lighted room before the test was begun. The walls and ceiling of the room were of rough plaster painted flat white. The room was illuminated by a centrally located ceiling fixture of the indirect type, specially designed to be completely glareless. To secure a higher illumination near the position of the observer than was given by the ceiling fixture, a floor lamp was used in addition, designed also to be completely free from glare. The horizontal component of illumination at the position of the observer was 16 ft.-c.; the component normal to the reading page 11 ft.-c. At the end of this period the observer was seated in position in front of the instrument. To compensate for inequalities in the time which this allowed for recovery of the eye at different sittings and further to complete and standardize the pre-sensitization of the eye, the test was begun by requiring the observer to look for three minutes into the illuminated pre-exposure field of the instrument. This field is circular in shape and subtends an angle of 36 degrees at the eye. The density of light in the field was 17×10^{-8} lumens per sq. mm. This value is approximately 550 times the average value of the light minimum for all the observers in the group at the beginning of the period of adaptation and 447,000 times that value after 20 minutes of dark adaptation. At the end of the pre-exposure period, the plate containing the stimulus aperture was dropped into position and the light reduced to threshold intensity as quickly as possible by the interposition of a neutral filter of the proper density and the rapid adjustment of the distance of the lamp of the instrument until the observer reported the disappearance of the stimulus. The light was then quickly increased until the stimulus reappeared and the point of reappearance was taken as the light minimum.

The light minimum was determined in this way at the end of the three minute pre-exposure period and at selected intervals thereafter until little or no change in sensitivity could be detected. The intervals used were 1, 2, 5, 10, 15 and 20 minutes. There was, of course, some slight variation in the time consumed in arriving at the final determination, but in general this time was no longer than three seconds. As might be expected, the data for the first point of the curve were found to be more variable than for the others, due to the fact that the exact time at which

the determination is completed exerts a greater influence on the results obtained at the beginning of the period of adaptation when the rate of change of sensitivity is at its maximum. In conducting the test, care was taken to reduce this variability to a minimum. The type of test instrument used was of great aid in this respect.

Two hundred and six eyes were tested, 114 of males and 92 of females. The persons examined included private patients, students, nurses, assistants on the hospital staff, hospital employees and a large number of clinic patients. In every case the refractive condition of the eye was carefully determined and an ophthalmoscopic examination made. No cases showing a pathological condition, however slight, were included in the group. The 206 cases ranged in age from 9 to 70 years. Ten fell in the group 5 to 15 years; 40 in the group 15 to 25 years; 64 in the group 25 to 35 years; 47 in the group 35 to 45 years; 36 in the group 45 to 55 years; 5 in the group 55 to 65 years; and 4 in the group 65 to 75 years. It was very difficult to obtain observers over 55 years of age who could be classed as completely normal in the ophthalmoscopic examination. Cases, for example, having arteriosclerosis, slight lenticular opacities and cloudiness of the media were not accepted. Because of the few cases in of the groups 55 to 65 years and 65 to 75 years, they were combined in the statistical treatment of the results.

Results

Early in the work it was realized that the older subjects tended to have higher light sense thresholds than the younger at all periods of adaptation and that, therefore, age would have to be taken into account in establishing borderline or critical values for clinic use. To determine the effect of age, the average and median values of light minimum were computed for each decade group at the end of the period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation. These values are given in Table I. From this table it is seen that there is a fairly consistent increase in the light minimum with age. The trend is shown most clearly for the longer periods of adaptation. This is due to the fact that the slower change in sensitivity at these periods makes it possible to obtain more exact measurements of the light minimum. Two reasons may be cited for this. (*a*) Check determinations can be made at these points and (*b*) variations in the exact time at which the final judgment is reached constitutes a less important factor in the results obtained.

TABLE I.

The average and median values of the light minimum in lumens $\times 10^{-10}$ entering the eye per sq. mm. of stimulus at the end of the period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation for the decade groups from 5 to 75 years. 206 non-pathological observers, ages 9 to 70 years.

Interval of → Adaptation		0 min.		1 m n.		2 min.		5 min.	
Age Group	Number of cases	Average	Median	Average	Median	Average	Median	Average	Median
5–15	10	2·83	2·44	0·240	0·203	0·073	0·060	0·0160	0·0133
15–25	40	2·32	2·21	0·195	0·187	0·050	0·038	0·0171	0·0161
25–35	64	3·16	2·36	0·274	0·221	0·065	0·054	0·0212	0·0161
35–45	47	3·34	2·41	0·317	0·263	0·073	0·080	0·0264	0·0209
45–55	36	3·84	2·72	0·232	0·221	0·083	0·071	0·0267	0·0221
55–75	9	3·59	2·21	0·346	0·263	0·097	0·069	0·0272	0·0197

Interval of → Adaptation		10 min.		15 min.		20 min.	
Age Group	Number of cases	Average	Median	Average	Median	Average	Median
5–15	10	0·0079	0·0065	0·0044	0·0042	0·0029	0·0017
15–25	40	0·0083	0·0077	0·0048	0·0039	0·0032	0·0027
25–35	64	0·0086	0·0072	0·0048	0·0037	0·0033	0·0030
35–45	47	0·0104	0·0119	0·0064	0·0064	0·0040	0·0037
45–55	36	0·0124	0·0102	0·0078	0·0073	0·0048	0·0044
55–75	9	0·0121	0·0112	0·0079	0·0076	0·0054	0·0044

For the purpose of determining norms for clinical use, it was decided to divide the observers into two groups—those below and those above 35 years of age. The following reasons may be given in justification of this decision. (*a*) Two sets of standards, one for cases below and one for cases above 35 years of age, are not too cumbersome to handle; and (*b*) particularly for the more reliable values (those obtained after five minutes of dark adaptation) there seems to be a rather clear differentiation between the average thresholds of the decade groups above and below 35 years of age.

For the more general statistical treatment of the results, however, the observers were considered in three groups: Cases under 35 years of age (N=114), cases over 35 years of age (N=92) and the total group (N=206). Results for these groups are given in Table II and Fig. 1. In the table are shown for the three groups the average and median values of the light minimum at each period of adaptation tested; the limiting values of light minimum for the total number of cases, for the middle 90 per cent. of cases and the middle 50 per cent.; and, as an index of the scatter of

TABLE II.

The light minimum in lumens $\times 10^{-10}$ entering the eye per sq. mm. of stimulus at the end of the period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation for the age groups below and above 35 years and for the total group: (*a*) the average values; (*b*) the median values; (*c*) the limiting values; (*d*) the limiting values of the middle 90 per cent. and the middle 50 per cent. of cases examined; (*e*) the median deviation expressed in 1×10^{-10} lumen; and (*f*) the median deviations expressed in per cent. of the median values. 206 non-pathological observers, ages 9 to 70 years.

Age Group	Interval of Adaptation	Average Light Minimum 1×10^{-10} Lumen	Median Light Minimum 1×10^{-10} Lumen	Limiting Values. 1×10^{-10} Lumen			Median Deviation	
				Total Number of Cases	Middle 90 per cent. of Cases	Middle 50 per cent. of Cases	1×10^{-10} Lumen	Per cent.
Below	0 min.	2·84	2·36	0·04 – 11·23	0·51 – 7·53	1·36 – 3·65	1·15	48·7
35	1 ,,	0·244	0·209	0·006 – 1·120	0·053 – 0·630	0·128 – 0·280	0·076	36·3
Years	2 ,,	0·0617	0·0543	0·0056 – 0·3138	0·0122 – 0·1445	0·0248 – 0·0866	0·0310	57·1
	5 ,,	0·0193	0·0161	0·0026 – 0·0937	0·0053 – 0·0475	0·0112 – 0·0227	0·0058	36·0
	10 ,,	0·0084	0·0076	0·0012 – 0·0236	0·0025 – 0·0176	0·0047 – 0·0117	0·0035	46·1
	15 ,,	0·0047	0·0037	0·0009 – 0·0146	0·0014 – 0·0102	0·0029 – 0·0058	0·0015	40·5
	20 ,,	0·0032	0·0028	0·0007 – 0·0092	0·0010 – 0·0071	0·0019 – 0·0043	0·0012	42·9
Above	0 ,,	3·53	2·46	0·47 – 14·45	0·88 – 9·67	1·84 – 4·41	1·29	52·4
35	1 ,,	0·297	0·236	0·050 – 1·445	0·059 – 0·800	0·133 – 0·340	0·104	44·0
Years	2 ,,	0·0785	0·0701	0·0131 – 0·3000	0·0209 – 0·1590	0·0382 – 0·1102	0·0359	51·2
	5 ,,	0·0264	0·0209	0·0051 – 0·0870	0·0075 – 0·0663	0·0133 – 0·0310	0·0089	42·5
	10 ,,	0·0120	0·0112	0·0026 – 0·0445	0·0043 – 0·0263	0·0068 – 0·0136	0·0034	30·4
	15 ,,	0·0070	0·0068	0·0014 – 0·0236	0·0025 – 0·0128	0·0044 – 0·0092	0·0025	36·8
	20 ,,	0·0044	0 0041	0·0010 – 0·0121	0·0014 – 0·0099	0·0031 – 0·0052	0 0011	26·8
Total	0 ,,	3·13	2·38	0·04 – 14·45	0·54 – 8·67	1·48 – 3·90	1·21	50·8
Group	1 ,,	0·267	0·221	0·006 – 1·445	0·057 – 0·747	0·130 – 0·300	0·085	38·4
	2 ,,	0·0692	0·0612	0·0056 – 0·3138	0·0136 – 0·1447	0·0306 – 0·1000	0·0347	51·7
	5 ,,	0·0224	0·0176	0·0026 – 0·0937	0·0067 – 0·0614	0·0128 – 0·0246	0·0059	33·5
	10 ,,	0·0100	0·0092	0·0012 – 0·0445	0·0029 – 0·0197	0·0052 – 0·0130	0·0039	42·4
	15 ,,	0·0057	0·0048	0·0009 – 0·0236	0·0015 – 0·0110	0·0034 – 0·0078	0·0022	45·8
	20 ,,	0·0038	0·0034	0·0007 – 0·0121	0·0011 – 0·0078	0·0024 – 0·0049	0·0013	38·2

results, the median deviations expressed both in lumens and in per cent. of the medians.

In Fig. 1A are given the adaptation curves derived from the 50 percentile or median value at each period tested for the group below 35 years of age, from the 25 percentile or first quartile value, from the 75 percentile or the third quartile value and from the 95 and 5 percentile values; in Fig. 1B, curves for these values are

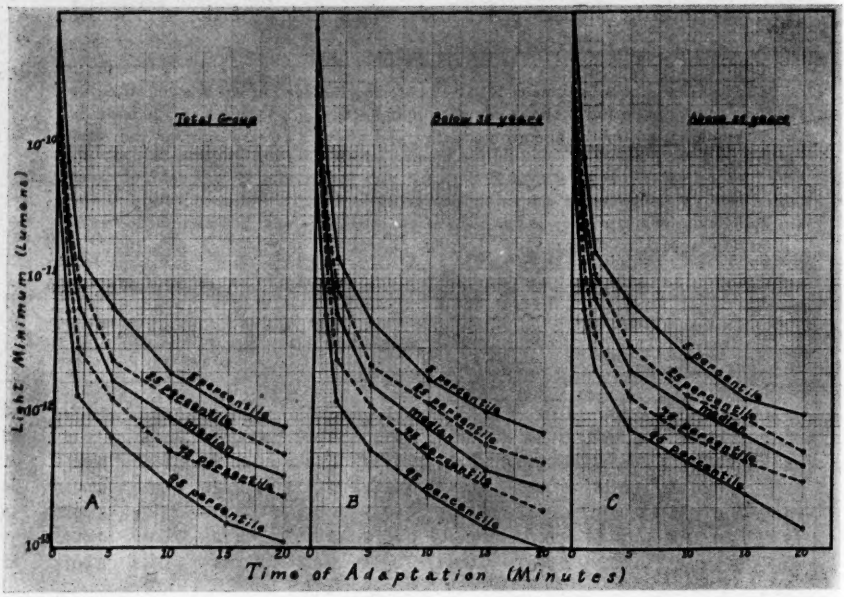

FIG. 1.

The light minimum for 206 non-pathological observers, ages 9-70 years, at the end of the period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation for the 5, 25, 50, 75 and 95 percentile cases: (A) for the total group; (B) for the group below 35 years of age; (C) for the group above 35 years of age. The light minimum is expressed in lumens $\times 10^{-10}$ entering the eye per sq. mm. of stimulus.

given for the group above 35 years of age; and in Fig. 1C, for the total group. The distance between the two limiting curves represents the middle 90 per cent. range of values; that between the second and fourth curves, the middle 50 per cent.

In Fig. 2 are given distribution curves of the results for the total number of cases at the end of the period of light adaptation and after 20 minutes of dark adaptation. Both of these curves

show that the values of the light minimum are not distributed normally in an unselected group of observers, but cluster at the lower end of the scale of values of light minimum, or at the upper end of the scale of sensitivities. In this we have conformity with the skewed type of distribution which is frequently found in measurements of simple sensory response, reaction time, speed of

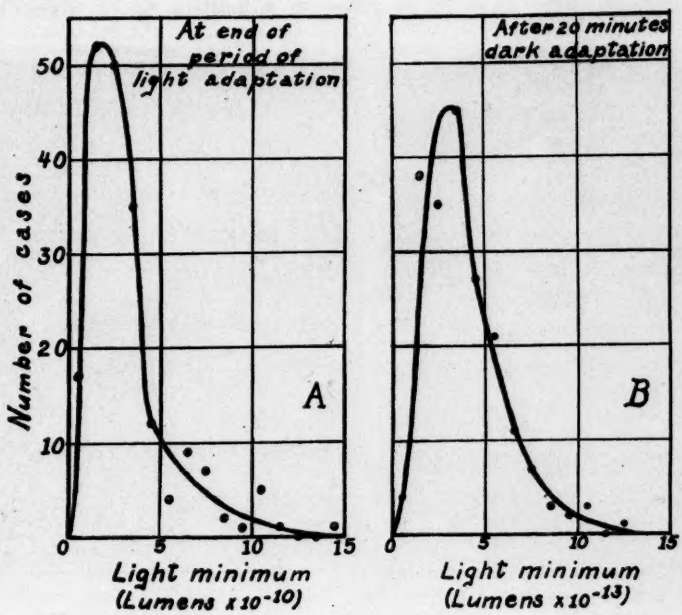

FIG. 2.

The distribution of the light minimum for 206 non-pathological observers, ages 9-70 years: (A) at the end of the period of light adaptation and (B) after 20 minutes of dark adaptation. The light minimum is expressed in lumens entering the eye per sq. mm. of stimulus.

response, etc. That is, a large percentage of cases give values which fall within the upper half of the range of power of performance and a small percentage, values which fall within the lower half. For example, in the present case the range of light minimum for the total number of observers at the end of the period of light adaptation is from 1 – 145 lumens $\times 10^{-11}$. In the lower half of this range fall 179 or 87 per cent. of the total number of cases; and in the upper half, 27 or 13 per cent. The range of

light minimum after 20 minutes of dark adaptation is from 7 - 121 lumens $\times 10^{-14}$. In the lower half of this range fall 176 or 85 per cent. of the total number of cases; and in the upper half, 30 or 15 per cent.

It might be regarded as interesting and important to treat individual differences in the amount and rapidity of dark adaptation numerically and statistically, as well as individual differences

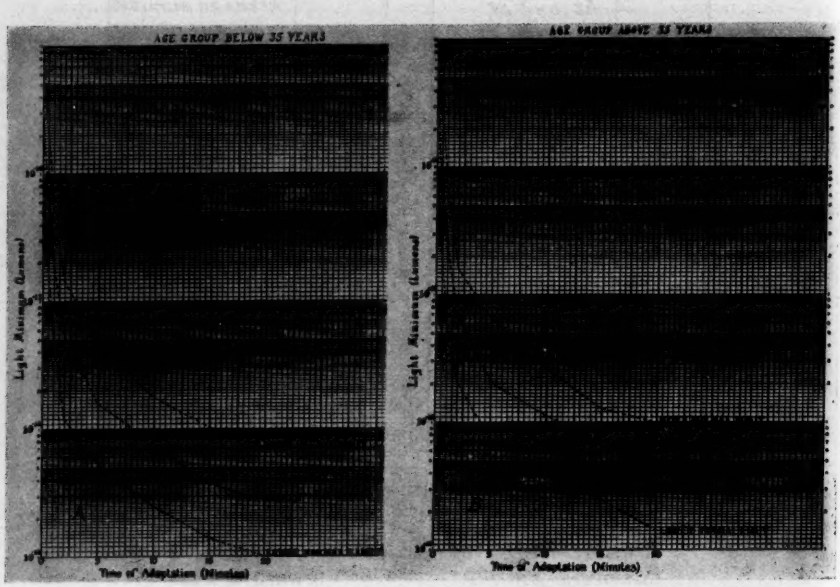

FIG. 3.

Record sheets on which the results for each new case examined may be plotted and compared with standard curves, representing the results for 206 non-pathological observers, ages 9-70 years.

in the light minimum. The importance of such treatment, however, is much less than it might seem to be because of the very great magnitude of the difference between the minimum before and after the period of dark adaptation—of the order of 1 to 1,000. In any comparison that might be made, therefore, the relationships from individual to individual will be very similar to those obtained for the values of the light minimum before the period of dark adaptation, too similar to justify the space that would be required for their presentation here. A sufficiently good conception of the individual differences in both of these respects can be had by

inspecting the shape of the adaptation curves, given in Fig. 1, which have been plotted at significant points in the distribution of cases.

For clinical application of the data on the light minimum, it was decided to select as borderline or critical the 5 percentile value at each period tested in the course of dark adaptation. The exclusion of the extreme 5 per cent. of high values of light minimum was thought to be justifiable in order to eliminate the influence of

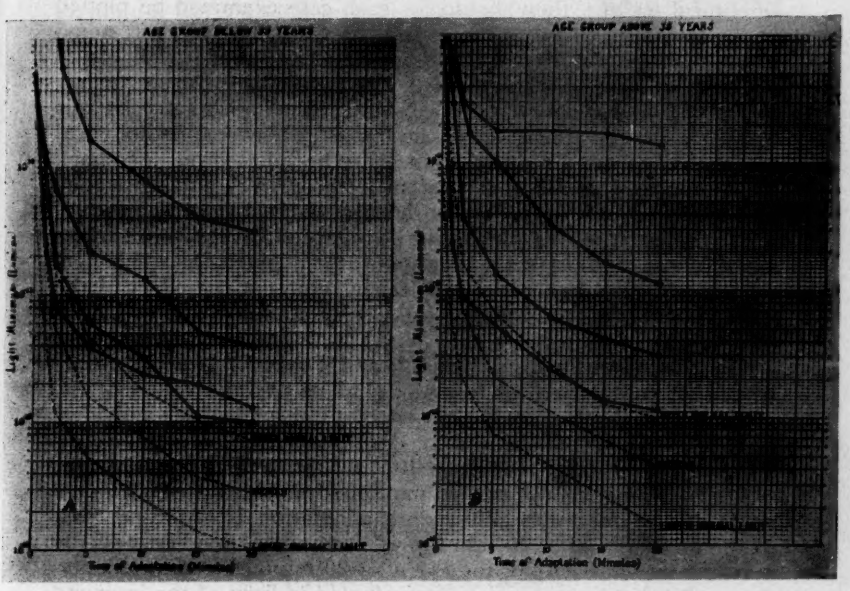

FIG. 4.

Record sheets on which are plotted the results for several pathological cases for comparison with standard curves representing the results for 206 non-pathological observers, ages 9-70 years.

chance observations, erratic judgments, fatigue, values affected unduly by the "streaming" phenomena which occur during prolonged periods in the dark, momentary fluctuations in the control of the physical conditions of experimentation, etc. These borderline values are shown in the upper curves of the record sheets reproduced in Fig. 3.

At A is shown the record sheet used for the younger age group, and at B that for the older group. In order better to aid in the orientation of any new case examined in relation to a suitably sampled group of non-pathological subjects, the median or middle

adaptation curve is also represented and the curve for the 95 percentile case, called in the chart the lower normal limit of the light minimum. When the curve for such a case has been plotted on the record sheet, inspection shows immediately whether it falls within or outside the normal limits, and whether above or below the median. Further, these items of information are readily obtainable for the early, middle or late periods in the course of adaptation.

For convenience of judging and preserving the results obtained in clinical testing, they should for each case examined be plotted in the form of a curve on the record sheet or standard chart noted above. When the Ferree-Rand instrument is made available to the medical profession these charts will be supplied with the instrument. Their use as record sheets is shown in Fig. 4. In this figure, in order to save space, the curves for several pathological cases which show a reduced light sense are plotted on one chart. These curves were taken at random from our files and since they are presented only to illustrate the use of the record charts and not to represent results which may be regarded as typical in various pathological conditions, the diagnoses are not given. In later papers we hope to give data which will fairly represent the effect of the various ocular diseases on the light sense and on dark and light adaptation.

The data given in Figs. 1 and 2, and Tables I, II and III may be further summarized as follows: (1) The average values of the minimum at the end of the period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation are respectively 3·13, 0·267, 0·0692, 0·0224, 0·010, 0·0057 and 0·0038 lumens $\times 10^{-10}$ entering the eye per sq. mm. of stimulus. (2) The average value of the minimum before dark adaptation is 824 times that of the minimum after 20 minutes of dark adaptation, i.e., on the average the sensitivity of the eye after 20 minutes of dark adaptation is 824 times as great as when adapted to light of the intensity used for the pre-sensitization period in this study. (3) The gain in sensitivity for the first two minutes was 4,429 per cent.; for the first five minutes, 13,893 per cent.; for the second five minutes, 124 per cent.; for the third five minutes, 75 per cent.; and for the fourth five minutes, 50 per cent. (4) The critical values for the light minimum at the end of the period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation are respectively for the group under 35 years of age 7·53, 0·630, 0·1445, 0·0475, 0·0176, 0·0102 and 0·0071 lumens $\times 10^{-10}$ entering the eye per sq. mm. of stimulus; and for the group over 35 years of age 9·67, 0·80, 0·159, 0·0663, 0·0263, 0·0128 and 0·0099 lumens $\times 10^{-10}$

In a later paper age, sex, condition of refraction and pigmentation as factors in the sensitivity to light and its change with dark

adaptation will be discussed. While sex, condition of refraction and pigmentation are factors, their influence is not of sufficient importance to require that they be taken into account in diagnosis.

Summary

In the foregoing paper the light sense and the amount and rapidity of dark adaptation are studied in relation to the needs and requirements in clinical work. Values are given for the light minimum on 206 eyes at ages ranging from 9 to 70 years, 114 male and 92 female. Determinations were made at the end of a standardized period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation. Curves were plotted to show the distribution and range of scatter of the results obtained and a brief statistical treatment is given to bring out points of interest and value in diagnosis.

For the purpose of determining norms for clinical use the observers were divided into two groups—those under and those over 35 years of age. The 5 percentile values were selected as critical or borderline, and were plotted in the form of a curve to be used as a standard in the examination of new cases. Two record sheets are shown, one for each of the age groups, on which this curve was plotted and in addition two other curves, representing respectively the median and the 95 percentile values, in order better to aid in the orientation of the results of any new case examined in relation to those obtained from a group of non-pathological cases. These record sheets should be supplied with the instrument used for making the test.

PRIMARY GLAUCOMA

The Respective Values of the Different Forms of Treatment of this Disease

BY

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THIS disease, primary glaucoma, as we know, is the subject of much debate as to its cause and as to the most effective manner of treatment.

With your permission I shall divide this disease into two kinds, *viz.*, that which is associated with non-cupping of the optic disc, and that form which has cupping of the optic disc.

The non-cupping variety passes through many stages, terminating with the acute inflammatory type, as to one division and a painless gradual loss of vision as to the other division of this type. The former progresses with varying degrees of severity of transitory attacks of plus tension and pain, till finally it passes into acute inflammatory glaucoma.

The other division of this type is associated with a gradual deterioration of sight and sometimes a little pain, rather an uneasiness, plus tension and very seldom an acute attack with pain. The length of time varies greatly in this gradual lessening of vision, namely one year or more.

In these two divisions of this type there is every degree of plus tension from the least to the greatest. The optic disc, however, does not show any signs of cupping, that is, the optic disc is the same as regards cupping, in the beginning of this disease as later on, and also even when there is T.+2 or T.+3. Also in the long-standing high plus tension of acute sympathetic ophthalmia, there is no cupping of the optic disc, as I have been able to verify in two typical cases of this disease, which under "The Combined Treatment" have recovered with good vision and with a clear view of the optic disc. Hence, the following conclusion might rightly be drawn, that plus tension cannot be held responsible for the cupping of the optic disc, unless one ignores much palpable evidence to the contrary. The preliminary stages of both divisions are usually treated with eserine drops chiefly and rest and later an operation, as iridectomy or one kindred in effect. When the disease, in spite of the use of the non-operative treatment becomes more severe, then the point is reached when the condition of plus tension and pain is relieved by one of the many operations advised. Sometimes the outcome is brilliant, if done at a certain stage of the disease, but when otherwise, the result is unsatisfactory. Then the only remedy left is another operation. Now the eye is in a hazardous condition and the list of the oculist's remedies has come to an end. Now the course is palliative and rest, in other words, the limit of the oculist's list is reached and he becomes an observer and onlooker merely, according to the present line of thought and action. A patient often then asks: "Will the other eye, which is now apparently normal, become similarly affected?" Truth compels the oculist to say "Yes," but we expect with a happier termination, unless the glaucoma is of the second division, when he will have to qualify his prognosis, as the treatment of this division is somewhat precarious.

This confession, seems to me, to be a proof that there is a decided lack of thoroughness in the treatment practised. My opinion is that the treatment of both divisions is defective, and

so convinced am I of the truth of this belief, that I have given up this mode of treatment. My only exception is an iridectomy in the very last stage of acute glaucoma and even then I do use, in addition, internal medicinal remedies to ensure success.

In regard to the variety with cupping of the optic disc the progress of the disease is gradual, painless, and ends practically in blindness, in spite of all the usual resources of treatment recognized and practised by oculists. The tension in these cases is plus and of such a character, that it seems unreasonable that it can be the cause of such deep cupping, especially of that seen in advanced stages. The usual treatment fails as a rule to stop the progress of the disease. The line of treatment consists of drops of various kinds and operations to relieve plus tension and to restore normal tension; for so unanimous are the oculists in ascribing the cupping and progress of the disease to plus tension.

The results of these operations seem to be a strong support of the belief that the treatment, to which oculists cling, is not correct in principle. It is rightly stated that the operative treatment of glaucoma is in a certain type of non-cupping though brilliant, uncertain after all.

In other non-cupping types the operative treatment may be successful, but the oculist cannot be sure; for he knows that he has often been sadly disappointed. Then further to emphasize my belief, that the whole line of treatment is apparently wanting in scope, is that the patient has to be told that the other eye will become affected sooner or later, and besides, that there is no actual preventive that can be said to be able to save the eye from the same disease that attacked the eye first affected.

This opinion may seem to give the impression of arraigning as ineffective the system of treatment, which has received the support of oculists for many years. If this thought be entertained, allow me to state that this disagreement with the views and practices of other oculists is founded, not only upon the results of this, another form of treatment quite different from theirs, and upon the success which has followed its use over a period of many years; but also upon my conception of the disease itself, which view has always strongly appealed to me, and has influenced and guided me in regard to treatment, till I have finally reached the decision arrived at in this paper. This statement of mine though previously made, but not with the same fullness of detail, may be thought to be rather sanguine and speculative; but the reasonableness of this conclusion of mine I shall now endeavour to establish by quoting facts and cases and by the inferences drawn from them.

The non-cupping variety of glaucoma is due, I think, to a certain type of cyclitis without the exudation of ordinary cyclitis,

but with the property of causing plus tension, which in the first division gives rise to increasing tension, till it ends in T.+2, or greater. In the second division it is limited to a moderate tension, variable and sometimes absent. In the beginning of the first division and almost up to the onset of the acute attack and severer pain, I have found that the disease could be got under control, in fact, could be cured, by eserine drops gr. 1/16 to 1/8 ad one ounce, 2.d. to the eye and pulv. hyd. c. cret.: et Doveri, one 2.d.s. one half-hour after eating and sodae iodidi, gr. 10, and sodae bromidi gr. 5, 3.d.s. one hour after eating. If at a more advanced stage I advise at once the use of "The Combined Treatment," or if at any time a satisfactory effect is not shown by the above medicinal treatment. In bad acute glaucomatous cases with much tension and pain, I do an iridectomy, and by giving, in addition, mercury and the iodide I make certain of a good recovery; for often after relief from pain and improvement of vision by operation, there begins a deterioration, which is halted by the added internal medicinal treatment. So thus you see, that one eliminates operative measures, save in the acute form with T.+1 or T.+2 and severe pain.

The variety of glaucoma, associated with cupping of the optic disc, I think, is not due to a cyclitis to begin with, but rather its origin is owing to an inflammation of the optic disc and of the nerve immediately behind it. Later on it gradually involves the ciliary region more in some cases than it does in others. An operation will, but not always by any means, be partially successful. But from my point of view I disapprove of any form of operation, for the plus tension as a reason is negligible. In cases, where though the cupping is quite marked but the lustre of the nerve head is good and the appearance fuzzy, the result of the following treatment is most encouraging, namely: eserine drops, mercury and the iodide, and bromide of soda; for you can see the cup gradually becoming more healthy-looking and shallower, and the field steadily improving. But when the cup is deep and its bottom has a bright glistening look, I begin with "The Combined Treatment;" for it is necessary at once to use the most powerful remedies. When, however, the tension is plus and the eye has to the finger-tips a doughy feeling, even though the vision is 6/9 almost, the prognosis is bad; for it means such extensive disease of the whole eye, that the sclera is involved. The fellow eye, however, with 6/12 vision and T. plus but a firm sensation with a certain elasticity of sclera will gradually deteriorate, but so slowly compared with the other eye, that the eye with vision 6/9 will and did become blind, whereas the other with 6/12 vision, recently seen by me after the lapse of four years, enables the patient to distinguish faces and readily go

about the house. The left eye four years ago held exactly the same vision as today, and the other, the right eye, was also blind then as it is today. The cup showed a bright glistening appearance about the same in each eye, which indicated a condition so serious, that ultimately there would be blindness or at the best poor vision in spite of any treatment, for the tissues of the optic disc and nerve are so hopelessly diseased.

My conclusions are, that in the beginning nearly all cases of the non-cupping and cupping varieties of glaucoma can, with few exceptions, be cured by the use of eserine, mercury and the iodide and bromide of soda. If, however, the improvement is not satisfactory then use "The Combined Treatment," for the latter treatment is much more powerful. This mode of treatment I consider more to be relied upon in every way than the treatment by operation. In regard to the cupping variety I am satisfied, that in the beginning, the medicinal treatment or "The Combined Treatment" is superior to the operative. When, however, this variety shows from the appearance of the cup that it is of long duration, even though the vision is fairly good, the result of treatment can only delay the final stage of almost blindness and in some cases blindness itself. However, sometimes I have secured a comparatively good result where I had despaired. Therefore this treatment is always justifiably used in these cases where there is any room for doubt, before finally deciding that the case is beyond help.

In the non-cupping variety, if one eye only is diseased and the other apparently not, this treatment will prevent the onset of glaucoma in the good eye. This result shows how wide and beneficial is the action of the non-operative system, as advocated by me. In the cupping variety I regard the medicinal treatment as the most trustworthy. My feeling is that the operative treatment is just about useless, being used as a last and the only resort with little belief in its ability to influence the disease.

Now with my present idea of treatment I no longer dread any ordinary case of glaucoma; for I have had such good recoveries with a continuous improvement from the beginning of the treatment.

One case of a non-cupping variety that I should like to mention is that of a man, J. R., of Toronto, aged 70 years. On examination I found right eye T.+2−, bare perception of light in outer field, cornea steamy, pupil dilated, etc. Left eye was T. plus, vision 6/9 poorly, and the usual glaucomatous field. He told me that when the sight of the left eye began to fail and was acting in the same way as the right eye did, that he was alarmed. He was fond of pigeon-shooting and became uneasy when he found that he could not see the bird in all parts of his field, as he swept his gun around. "The Combined Treatment" saved the right eye from excision, but not from blindness, and as to the left eye it became normal. In this case at the end of four years the eyes were in the same condition as when the treatment was stopped, his general health was also greatly improved as is usually the case with "The Combined Treatment."

My treatment of this case, had I used the usual routine, would have been to have excised the right eye and to have done an operation upon the left eye, one of the many so warmly advocated. Any one of these would have at the time restored the eye to T.n., and might have given vision of 6/9, but no more for after an operation, the vision heretofore present, as in this case, would likely become lessened. Then, as to the eye's future, whether he could count on a fully restored eye or had to fear a slow relapse would have had a doubtful answer given, and besides, his general health would have remained the same, or perhaps, have become worse.

The picture of the result of "The Combined Treatment" is right eye retained, but blind, left eye 6/6 vision and a good prognosis without any reservation and excellent health and spirits.

I shall now give some of my notes regarding a case of the cupping of the optic disc variety.

Miss W., aged 48 years, Toronto, first consulted me November 15, 1915. It was a case of refraction, and the glasses she was wearing were decidedly incorrect. There was hyperopic astigmatism and presbyopia. I gave her glasses, first using homatropine as the eyes showed much retinal irritation. Each eye T.n., ps. a., optic discs normal, fields normal, and vision with glasses 6/6 not fully each eye.

December 24, 1923. Since the above date, 1915, this patient has not been seen by me. She says the glasses were quite comfortable. Now she complains of a dull, heavy feeling of the left eye. She says that on and off for four years the left eye was troublesome and, when she was very tired, saw rainbow colours. At times she says that the eye was quite easy. Right eye 6/6 not fully with glasses, T.n., p.a. optic disc normal, and field normal; left eye T.n., vision 6/15 with glasses, pupil slowly active and does not contract as fully as right eye, and the pupillary margin has a distinctly atrophic look, media clear, optic disc deep cup slightly shelving towards outer edge, and nasal field lost, general health poor. The treatment prescribed was eserine drops gr. 1/16 to 1/8, ad one ounce 2.d. into left eye, pulv. hyd. c̄ cret., et Doveri, 2d.s. half an hour after eating, and sodae iodidi gr. 10 and sodae bromidi gr. 5, 3.d.s. one hour after eating. She continued the treatment till June, 1924, when she contracted pneumonia and died after three days' illness. The patient visited me one week before her death and was quite well. Left eye was as follows: T.n., p.a., but does not contract quite as well as right pupil, the atrophic look of the margin of the pupil has gone, and the normal nasal field almost restored, media clear, vision 6/6 not fully with glasses. There is still a marked cupping of the optic disc, but it is healthier looking as to lustre and has a fuzzy appearance instead of a glistening effect, is shallower, general health is excellent.

As the improvement was so steady and so satisfactory I had not used "The Combined Treatment," but if at any time had there been a slowing down as regards improvement I should at once have done so. The improvement of the eye and general health was so well sustained, that the patient, now aged 57 years, was very pleased and frequently remarked upon it. Had I been able further to proceed with my treatment I should have watched with much interest the recovery of the optic disc; for it was gradually and noticeably getting healthier-looking and shallower.

It seems to me that I have a right to attribute the improvement in the aspect of the optic disc to the treatment, and I think that finally its condition would have resembled closely a physiological cup. And why should it not have gone on improving with the continuance of the treatment, till it became as before the attack, if not exactly a normal optic disc, still one that would have had the resemblance and power of a normal physiological cup. It does appear to me that the tension manifestly could not have been the cause of the cupping. The appearance of the pupil and iris showed that the pathological changes, apparently begun in the optic nerve, had slowly in four years or more, crept forwards, till the ciliary region was implicated. The usual treatment would

of course have been an operation on the left eye with a doubtful prognosis as to its future. Surely the operative treatment ought to have enabled the oculist with assurance to have given a good prognosis, if an operation in these cases was ever going to be able to be considered, as radically effective.

The operative treatment besides giving a doubtful prognosis as regards the future of the eye could only express with regard to the right eye the hope that it would not be affected. Whereas the treatment outlined in this paper and its results would warrant a well-founded, decidedly favourable prognosis as to the left eye, and as to the right eye freedom from any glaucomatous attack.

In regard to the loss of the nasal field in both types of glaucoma this condition is thought to be associated with plus tension, in fact, is so asserted by oculists. In the non-cupping variety the plus tension appears to be due to the cyclitis, which interferes with the circulation of the angle of the anterior chamber. Hence its slight and evanescent character, as a rule, to begin with and the fact that, with no treatment or with unsuitable treatment and faulty hygienic control of the eyes, it becomes greater and more persistent as the disease progresses. Then, that an operation at a certain stage seems to cure, at another relieves and does not cure, is due to the condition of the ciliary region as to the duration and severity of the disease of that region. In these cases the medicinal treatment brings about a recovery by its action upon the diseased ciliary region. In the cupping variety of glaucoma there is a plus tension, very moderate in character and sometimes absent. One is surely pardoned if he fails to grasp, to understand the line of thought of those who declare that the cupping of the optic disc is due to the pressure of plus tension, when in another form of glaucoma in which the optic disc is subjected to the pressure of a plus tension slight to begin with, but finally after a time is increased to T.+2 and even T.+3; there is not produced at any stage of the plus tension any sign of cupping of the optic disc.

In the cupping variety of glaucoma the loss of the nasal field seems to me to be due to local pathological changes in the optic nerve. In this form the plus tension is moderate and is apparently due to involvement of the ciliary region which cyclitis does not bring about the same radical change in the angle of the anterior chamber, as it does in the non-cupping variety.

In cases of retro-ocular neuritis there is no cupping of the optic disc and no increase of tension, with a central scotoma and besides, the optic disc has a normal appearance long after the beginning of the neuritis. As the pathological changes taking place in the optic nerve in one of these diseases cause cupping of the optic disc and loss of the nasal field, and in the other no semblance of

cupping and a scotoma, it seems as if the difference can only be accounted for, but not as yet explained, in the peculiar character of the neuritis. Here I am strongly of the opinion is a most interesting field for pathological research and one far reaching as regards the deductions which will naturally follow its successful working out.

In the non-cupping variety of glaucoma the nasal field is lessened or lost through a plus tension, its presence arising as it does from changes in the ciliary region, that is, the anterior part of the eye. Thus this condition is a question presumably chiefly of mechanical pressure, which can consequently be so sudden and so destructive in its effects and is not associated with any marked pathological change in the optic disc. The loss of the nasal field in the cupping variety is due to local changes in the optic nerve and not to pressure, whereas in the non-cupping the nasal field is lost through pressure.

Thus it is evident that in the non-cupping an operation can be of benefit and that in the cupping it is of such questionable value. Of the cupping variety of glaucoma and of retro-ocular neuritis the medicinal treatment in which term is always included "The Combined Treatment" does bring about a cure if used in the early stages of these diseases; but if later, then though the healing of the diseased tissues takes place often it is too late to restore these tissues to normalcy.

However, "The Combined Treatment" does prevent the extension of these diseases to kindred tissues of the other eye by healing the diseased tissue of this, the affected eye. Thus, it prevents the infection of the so-called healthy eye, and also it has a salutary action upon the good eye itself. This idea, rather this fact, thus upholds my theory of transmission of an injurious influence along the kindred nerves to the other eye, as in the case of acute sympathetic ophthalmia, and also of a healing influence along these same nerves. This healing influence is really forced into greatly heightened and sustained activity through the use of "The Combined Treatment" (for remember, it never causes an unhealthy influence), and thus it is enabled ultimately to overpower the one-time stronger, inimical influence. Moreover, we know that this abnormal influence can be quickly checked if attacked early in the disease, but otherwise the contest waged is very great and long before this malign influence is overcome and victory is at last won; for this pernicious influence, as proved, has been and can again be subdued, and thereby rendered inert and innocuous.

Therefore, it seems to me to be a natural sequence to express the opinion, that the comparison regarding the merits of the respective treatments of glaucoma is not overdrawn; but is a well-balanced résumé, which appears to me to justify the conclusion

that the internal medicinal treatment, as advocated in this article, is superior in many ways to and more to be relied upon than the usual modes of treatment of this disease—primary glaucoma.

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(In this paper there is given by request of oculists a detailed account of the mode of administration of this treatment).

THREE UNUSUAL CASES OF FOREIGN BODIES IN AND ABOUT THE EYEBALL*

BY

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To those who attended the meeting of this Society held at Hot Springs in 1920, or to others who may have read its transactions for that year, the identically similar title of this, with my previous paper, will immediately be apparent. The earlier article was presented with the more particular appeal, and possibly with some unusual element of interest, to those who had seen service in the Army Medical Corps. The value of the paper, however, as in so many presented before this Society, consisted, not so much in the article itself, as in the interesting and varied discussion and contributory elements of information which it evoked.

The cases about to be recorded occurred in civil life and are comparable to the former ones in one respect in particular, and that is, that the term "unusual" is even more emphatically applicable. The offerings are definitely alike in that the foreign bodies were retained for a considerable period of time, but absolutely incomparable regarding the nature or character of the accident and the quality of the material responsible for each injury.

I acknowledge, at the outset, that as subject of an ultra-scientific character, supplied or supported with a pathological background, or possessing a bio-chemical problem, as seems to be essential in so many of the articles read at present day meetings, it is valueless. As supplying a short series of varied practical problems which the majority of us have to face, not as laboratory workers, but as practising ophthalmologists, the cases may possibly convey some information and possess some worth.

* Read before the American Ophthalmological Society, July 10, 1934.

Case 1.—F. McL., aged 52 years, Canadian, was referred to me in November, 1933, by the Canadian National Railroad Company. The man stated that eight years previously he had been working in a drain and that after striking a pipe something flew into his right eye. As far as the patient could remember the pipe was cement and the hammer was steel. Sight was lost almost at once. He consulted an oculist of unquestionable repute who, after having the eye X-rayed, appreciated the character or nature of the injury and advised him to leave the eye alone. The man followed his vocation as a mechanic through the years, suffering little or no pain, and reported to the medical staff of his company

FIG. 1.

Absence of impression of large piece of concrete seen in anterior chamber and retained in eye eight years.

owing to the eye having recently exhibited evidences of pain and inflammation.

The railroad authorites supplied me with X-ray plates of the eye and orbit which were negative in all particulars (Fig. 1).

The conjunctiva bulbi showed a moderate degree of injection while the anterior ciliary vessels about the limbus corneae were unquestionably engorged. No evidence of a previous penetrating wound could be made out, the anterior chamber was of normal depth, and the eyeball was not tender on pressure, or soft. The pupil was moderately contracted, the lens, in so far as one could see it, was cataractous, with calcareous degenerative changes about the capsule and light perception was absent. In the lower filtration angle there appeared a foreign body of crescentic form, the concavity directed downward. It measured about 2×4 mm. Viewed with the slit-lamp it did not present any of the characteristic appearances of a metallic substance, but gave one the impression of a tiny piece of dark brown Russian leather. There

was a natural attendant iritis, as manifested by an intense posterior bedewing, although a so-called punctate keratitis as clumps or dots on the back of Descemet's membrane did not show up with the lamp.

I did not dare dilate the pupil for fear of the foreign body possibly falling backward. Eserine, rather, was instilled, with the idea of further contracting the pupil, and the patient was referred to the wards. The eye was again photographed, but,

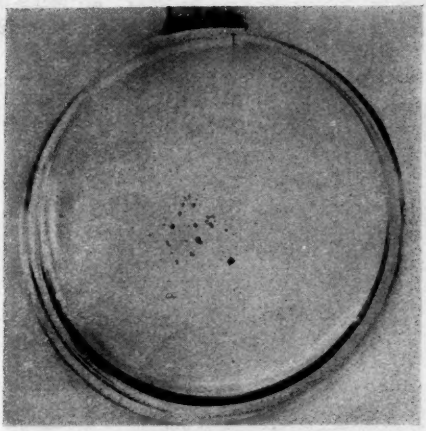

FIG. 2.

Piece of concrete which fragmentized after being removed from the anterior chamber.

as in the earlier plates, no foreign body was recorded, although one was definitely present before our eyes. The patient was subjected to the giant magnet and under the highest power no drag could be elicited. He was then brought to the operating room, and when placed on his back the foreign body slipped gently from a point representing "6 o'clock" to one representing "9 o'clock." There could consequently have been no adhesions binding the foreign body to the iris. The anterior chamber was opened with a keratome at the limbus and Lancaster's hand magnet was applied directly over the foreign body, but still no reaction was manifest, proving emphatically the non-magnetic character of the substance we were dealing with. A pair of Kalt forceps was then introduced into the anterior chamber and the substance removed, breaking into two pieces as it was extracted from the chamber (Fig. 2). It was brittle and felt like a piece of

cinder or concrete. The eye ultimately had to be removed some time after as it still remained irritable, another foreign particle unquestionably being still retained farther back where it could not be seen or reached. A general physical examination revealed no positive information that one could interpret as being an associated or contributory factor in the eye continuing irritable. A condition of interstitial keratitis was in progress, the circulation of blood

FIG. 3.

Tumour of upper lid simulating Meibomian or sebaceous cyst.

corpuscles being clearly detected in the parenchyma of the cornea by the slit-lamp.

Case 2.—A French-Canadian carpenter, aged 32 years, was sent to me by the Canadian National Railroad Company last year. He stated that three months prior to his coming to me a small lump had appeared over his right upper lid, that it was gradually becoming larger, and that recently it was causing the lid to droop. The swelling had never manifested the slightest evidence of inflammation, and the lump had never been tender or painful to the touch (Fig. 3). Vision had been in no way affected. He could not offer any reason for its presence more than an individual can explain that of the average Meibomian cyst. Indeed, it was not unlike a tumour of this character in many respects, except that it seemed to originate somewhat above the upper margin and to the temporal side of the tarsal plate, just beneath the upper ledge

of the orbital wall. If not Meibomian in character it might have suggested a sebaceous cyst, and failing this the very remote possibility of a meningocele. The skin was not red or glistening, and moved freely over the underlying mass, while the tumour itself did not appear to have any deep attachments, but could be readily defined laterally and palpated by the fingers. No element of tenderness could be elicited. There was no maintained ptosis, and the action of the extrinsic muscles was unimpaired. The fundus was normal, and vision was 6/6.

Faced with such an element of interrogation an X-ray photograph was taken, and much to my surprise a narrow band-like

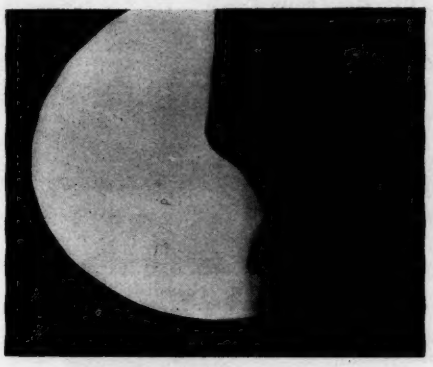

FIG. 4.

Shadow of foreign body running backward into the orbit.

shadow was thrown from the margin of the frontal bone backward in the direction of the apex of the orbital cavity (Fig. 4).

With the usual aseptic precautions a horizontal incision was made through the skin over the mass and when the orbicularis fibres were separated a glistening long, tiny, sausage-like body presented itself. It proceeded directly backwards into the orbit, not unlike the average meningocele, but unlike those structures it was tough and resistant, apparently attached behind and supported by some hitherto non-defined element within the cyst wall. A pair of artery forceps was attached and traction was applied to facilitate dissection. As this proceeded the capsule broke, and a straw-coloured fibrinous exudate escaped. With the rupture of the capsule a clear view was afforded of two long wooden splinters occupying the cavity, not unlike toothpicks, completely encapsulated, stained a coffee-brown colour and

measuring 3·5 cm. in length (Fig. 5). The completion of the operation and the patient's subsequent recovery were uneventful.

With the previous negative history regarding the source of origin of the tumour, and being again pressed for an explanation, with the assistance of the specimen, the man supplied this rather remarkable story. He stated that when working under a scaffolding three and a half years previously, a piece of wood had fallen from above striking him evidently just above the eyeball. There was no pain or bleeding at the time, no subsequent discolouration of the lid, no impairment of vision; and after the man had

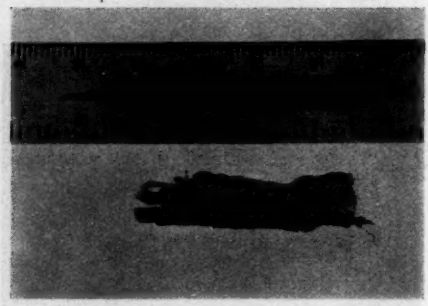

FIG. 5.

Cyst formation about splinter of wood retained in orbit for three and a half years.

recovered from what he considered as a very minor accident he proceeded and continued with his day's work.

Case 3.—An American farmer, aged 51 years, consulted me in 1927. He came over the Border, not with the preconceived idea at this arid time of having a look at the Promised Land, but because his left eye had been causing him a great deal of annoyance at regular intervals for many years. From the man's replies, and after a most insistent interrogation, no history of trauma was provided, and from his statements and descriptions of his symptoms he seemed to have been suffering from some seasonable affliction, such as a vernal catarrh, or possibly from some type of protein reaction, which would clear up for a period only to break out again. The right eye was normal in all particulars.

The left eye was acutely inflamed, circumcorneal injection being particularly pronounced. The anterior surface of the cornea was clear and showed no evidence of a previously penetrating wound; but the posterior surface was relatively beclouded by lymph, although no punctate dots were present on Descemet's membrane.

The iris was distinctly swollen and its tracery blurred, its stroma exhibiting the characteristic greenish colour of an intense iritis. No posterior synechiae at the pupillary margin were present.

At the nasal side, midway between the pupil and the filtration angle, and slightly above the horizontal axis, was a definite mass measuring approximately 1 × 2 mm. It was fixed to the iris. Viewed with the slit-lamp it appeared to be pearl-grey in its centre with reddish-brown pigment above, and a dense melanotic appearance below. It was definitely raised from the iris surface, to which, as I have already stated, it seemed to be attached like a wart; but it did not seem to be vascularized. A definite posterior bedewing and a more or less albuminous aqueous naturally prevented a clear definition. There was nothing in any way suggestive of a foreign body possessing a metallic character. The lamp showed no lymph exudate on the anterior lens capsule, and no pigment cells or posterior synechiae seemed to have proceeded from the pupillary margin. The optic disc and vessels were normal, there were no opacities in the vitreous, and vision was 6/36, not improved.

With a clear cornea and with an absolutely negative history of trauma, as in case 2, I had to anticipate the possibility of a tiny melanotic sarcoma of the iris associated with an acute iritis. The eye, however, was X-rayed, and an apparent foreign body was localized exactly where I had described my findings on the iris surface (Fig. 6). Magnet reaction was negative. The anterior

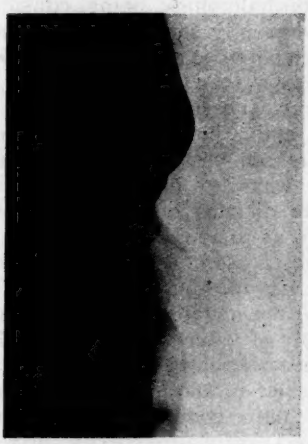

FIG. 6.

Tiny particle of stone retained in the eye for thirteen years.

chamber was opened at the limbus, and when the iris was withdrawn a tiny round pebble fell into the lower fornix. Recovery from the operation was uneventful, and the patient's subsequent visual acuity was 6/7. He has remained comfortable ever since.

When the character or source of his trouble was shown him, the patient was only then able to recall the possible origin of his disability. It appeared that when working a potato harvester 13 years earlier a tiny particle of stone must have struck his right eye. Vision, doubtless due to a penetrating wound of the cornea and to loss of aqueous, was blurred for a short time; but by the following day it did not appear to be in any way impaired. The man evidently suffered attacks of sub-acute iritis during the course of the years, which fortunately did not produce very serious complicating sequelae.

You will have noticed, following the recital of these three dissimilar cases, that they vary considerably from those presented in my former contribution; in one in particular, in that the foreign bodies were all non-magnetic. For that reason the discussion previously provided relative to the action of magnets, and to the behaviour of metallic foreign bodies under their influence may at once be put aside. For those who desire further information, I cannot do better than refer them to the very excellent article and appended literature by Franklin and Cordes which appeared in the *Amer. Jl. of Ophthal.*, in July, 1922. But in reviewing the cases, few in number, it is true, there are certain features which must have struck our attention. The point that has attracted mine is, that in spite of ophthalmology being considered a progressive science, only too frequently some one of the more refined sources of diagnosis, if taken alone, is prone to lure us away from the paths of common sense to a road which leads to fallacy or possible disaster. The X-ray, the tuberculin reaction, the Wassermann test, blood counts, and a host of other tests may at times be of value, but at others can best be described as Sirens beckoning us along devious ways to follow erroneous impressions and opinions which the dictates of our human senses, if properly applied, would help us to avoid.

Elements of fallacy arose in each of these three cases; not under every circumstance I grant you, otherwise my argument would be unstable. But take the negative finding of the X-ray in case 1; while unquestionably of value in cases 2 and 3; it failed to reveal a relatively large piece of concrete or cement in one instance, while it detected the presence in another eye of a much smaller particle of stone from which the concrete was undoubtedly made. The slit-lamp overpainted the picture in case 3, while undoubtedly it contributed some element of information in case 1. The final source of fallacy, of course, must be regarded as the instability of

the personal equation when searching for a dependable and intelligent history as in cases 2 and 3. The patient's replies honestly given undoubtedly smeared the issue in each of the last two cases.

This small series of reports is brought forward, each presenting a special feature and each a particular problem, and for that reason they possibly possess some value. They must not be considered as having been reported with any idea of depleting such an inexhaustable subject. That they are fortuitous, I am ready to admit; otherwise I would not have deemed them worthy of your attention.

THE PHENOMENAL VISUAL ACUITIES OF THE EUROPEAN CHIMNEY SWALLOW

BY

S. HOLTH

OSLO

IN Casey A. Wood's "The Fundus Oculi of Birds," Chicago, The Lakeside Press, 1917, the author states that *Hirundo rustica* has a trimacular fundus; one nasal fovea for monomacular vision for far distances and two temporal foveae for bimacular vision in short distances. In the chromolithograph after Arthur W. Head's painting (1*c*, Plate L) only two of the three foveae are visible; the most external temporal fovea is outside the area of the reproduction.

In July, 1913, I convinced myself that *Hirundo rustica* has phenomenally sharp vision both for far and short distances. In

The dry fly "Black Gnat" on
000 "Hardy" hook (Size 1/1)

bright sunshine the swallows hunted tiny insects—mostly the common midge, *Culex pipiens*—very high up in the air and often in full speed changed the direction in acute angles. Suddenly one of them from at least 20 metres height became interested in my little dry fly "Black Gnat" on 000 "Hardy" hook during trout fishing and rushed down to it; but in about one metre's distance from the dry fly the swallow stopped abruptly with the

wings transversally; he observed with his temporal foveae perhaps the little hook—if in profile as in the illustration—but certainly the hairfine (0·006) undyed transparent drawn gut cast, which he had never seen connected with any living insect; with his nasal fovea he had monocularly detected the fly itself from at least the distance of 20 metres.

I admired the animal, but found it safest in the future never to fish with the dry fly when swallows are hunting in the landscape.

ANNOTATION

The Combined Treatment in Glaucoma

In common with most other scientific journals, the *Brit. Jl. of Ophthal.* does not accept responsibility for the views of authors of original communications. Our present number contains an article on the treatment of glaucoma by Dr. G. Herbert Burnham, which may possibly not be entirely acceptable to many of our readers. The proposition that many cases of primary glaucoma can be overcome by non-operative treatment may seem rather revolutionary; but it must be remembered that, although glaucoma as a sign can be put into the water-tight compartment of raised tension, the causes of the condition are probably manifold, and in practice no two cases may be quite the same. Dr. Burnham in his paper does not submit a very large number of cases relieved by this method of treatment, but this may be a kindly desire on his part to save our space. The fact remains that he is a very senior member of the ophthalmic fraternity, an old house-surgeon at Moorfields and one of the few surviving original members of the Ophthalmological Society of the United Kingdom still in practice. He is convinced of the beneficial effect of his method of treatment in such cases, and it is only fair that he should be allowed to state views founded upon long experience. As our ideas about the cause of primary glaucoma are being revolutionised by the cumulative effect of research work in many lands, it is reasonable to hope that at no distant date we may understand the underlying principles of this condition; and, when the cause is known the methods of treatment may have to be varied. With a view to the future, therefore, we are publishing the paper that our readers may become acquainted with a treatment, of which little has so far been heard in this country.

ABSTRACTS

I.—RETINA AND OPTIC NERVE

(1) **Meyerbach, F. (Aachen).—Pigmentary degeneration of the retina and internal secretion. (Degeneratio Retinae pigmentosa und innere Sekretion).** *Folia Ophthal. Orientalia*, Vol. I, Fasc. 3, p. 317, 1933.

(1) **Meyerbach** assuming that pigmentary retinal degeneration may be caused by a partial deficiency of female sexual hormones, has treated this disease by subcutaneous and oral administration of menformon, a preparation from female sex glands. He describes a remarkable case of his own in which intensive menformon therapy was followed by striking improvement in the visual fields. He attributes this success to improved metabolism in parts of the retina which are functionally depressed but not entirely degenerate and useless.

H. B. STALLARD.

(2) **Koyanagi, Y. (Sendai).—On the origin and significance of the subretinal effusion in renal retinitis. (Ueber die Herkunft und Bedeutung des subretinalen Ergusses bei Retinitis nephritica).** *Arch. f. Ophthal.*, Vol. CXXXII, p. 353.

(2) **Koyanagi** in this article claims that detachment of the retina, so far from being a rare occurrence in renal retinitis, is in reality a frequent and important complication, especially towards the close of life.

He examined 11 cases of retinitis nephritica clinically and anatomically; retinal detachment was observed clinically in five, and histologically in all cases.

This detachment is due, not to an inflammatory exudate or a transudate from the vessels of the choroid or retina, but to a primary " effusion " in the subretinal space, which is in the main a pathological secretion from the retinal pigment epithelium.

This secretion, which is rich in hyaline substance and albumin, begins in the form of fine hyaline drops which, as the microphotographs reproduced in this article show, are projected from the epithelial cells, and by the coalescence of these drops ultimately develop into an apparently amorphous, semi-transparent, faintly yellow mass of rubber-like consistence, which is relatively firmly adherent to the pigment epithelium, but is easily detached from the retina. These changes in the retinal epithelium are entirely

independent of the co-existent renal or angiospastic retinitis. Through the long continued secretion the pigment epithelium cells may undergo degeneration, and possibly the secretory process and degenerative changes may go on simultaneously.

This secretory function on the part of the retinal epithelium the author regards as a defensive reaction against toxic substances circulating in the blood.

THOS. SNOWBALL.

(3) **Koyanagi, Y. (Sendai).—Morphological blood changes in renal retinitis. (Morphologische Blutveränderungen bei Retinitis nephritica).** *Klin. Monatsbl. f. Augenheilk.*, Vol. XCI, p. 168, 1933.

(3) **Koyanagi** recalls Sitzner's observation of basophil mast cells in contracted kidney, similar to those seen in lead-poisoning. As the phosphatides in the blood have an haemolytic action and these produce many red blood corpuscles of varying stages of development, including basophil staining cells, the author investigated the phosphatide content of the blood in cases of renal retinitis, and found it increased. Drawing on the analogy of poisoning with Toluledíamin in which the mast cells are also increased and in which a deleterious action on the capillary wall is found, the author argues that the lesions in renal retinitis are to be explained by the increase in the blood phosphatide bringing with it haemolysis and damaged capillary walls.

ARNOLD SORSBY.

(4) **D'Osvaldo. (Padua).—Colour and light-sense in patients suffering from nephritis, in whom central acuity was normal and fundus change was not seen. (Ricerche cliniche sul comportamento del senso luminoso e cromatico centrale e periferico nei nefriti senza alterazioni oftalmoscopiche neuro-retiniche e con acutezza visiva centrale normale).** *Lett., Oftal.*, November, 1933.

(4) **D'Osvaldo** has examined the light and colour-sense in patients suffering from nephritis who had normal central vision. He finds that many of these subjects have a greatly reduced colour-sense, especially of the macula; and that a large proportion show a reduction of light-sense both central and peripheral. There is no parallelism between the behaviour of the two functions. He concludes that there is some toxic substance retained by defective elimination in the circulation, which effects this disturbance of sensation.

HAROLD GRIMSDALE.

(5) **Pollnow, L. (Königsberg).— The familial factor in retinitis circinata. (Ueber familiare Beziehungen bei der Retinitis circinata).** *Zeitschr. f. Augenheilk.*, Vol. LXXXI, p. 164, 1933.

(5) **Pollnow** reports a case of retinitis circinata followed over a number of years. The patient's aunt had the same affection, whilst a sister suffered from bilateral glaucoma. The author discusses the questions of arterio-sclerosis and familial incidence in retinitis circinata.

ARNOLD SORSBY.

(6) **Haas, E. and Schmidt, K. (Bonn).—Non-operative treatment of retrobulbar neuritis. (Zur Frage der nichtoperativen Behandlung der Neuritis retrobulbaris).** *Zeitschr. f. Augenheilk.*, Vol. LXXIX, p. 449, 1933.

(6) **Haas and Schmidt** followed up 15 cases of retrobulbar neuritis of diverse aetiology. They conclude that expectant treatment gives as good results as operative interference. In several instances recovery set in without treatment in cases with rhinological findings. They point out that unilateral retrobulbar neuritis tends to run a favourable course and that the prognosis is distinctly worse in bilateral cases.

ARNOLD SORSBY.

(7) **Perritt, Richard A. (Chicago).—Optic neuromyelitis.** *Arch. of Ophthal.*, March, 1934.

(7) **Perritt** in his article describes two cases of this rare disease, and gives a general survey of it. The optic neuritis is bi-lateral, may occur in the disc or further back, and may be acute or subacute, being followed in a variable length of time by myelitis. The mortality is 50 per cent., and in those patients who survive, return of vision is always slow, but occurs in 50 to 60 per cent. The acute form is the commonest, vision even down to perception of light being lost within a few days or even within 24 hours. There may be severe orbital pain and in some cases, complete ophthalmoplegia. The amount of neuritis visible with the ophthalmoscope depends on the position of the lesion in the optic nerve. The two eyes may be affected simultaneously or at a variable interval. The myelitis also occurs at a varying interval after the optic neuritis, and in some cases may precede it. Syphilis, tuberculosis and alcoholism have all been cited as causes of the condition, but the majority of cases are found in persons otherwise healthy. Histologically, there is leucocytic infiltration of all the

layers of the optic nerve with degeneration of the optic tracts, and in the retina extreme thinning of the nerve fibre layer and diminution of the ganglion cells.

F. A. W-N.

(8) **Caramazza, F. D. (Bologna).—On the condition of the retina and the optic nerve in some anencephalic monsters. (Sullo stato della Retina e del Nervo offico in alcuni mostri anencepali).** *Rev. Oto-Neuro.-Oftal. e Radio Neuro. Chirur.*, Vol. XI, No. 3, p. 218, 1934.

(8) The theories of the causation of anencephalia are numerous. Some authorities think it is due to a ventricular hydrops, the compression causing arrest of development of the brain, others that it is caused by imperfect development of the amnion in the cerebral region, or that it is an arrest of development before the formation of the cerebral vesicles.

Changes in the endocrine organs have been noted in some cases and have been quoted as the cause.

The lack of supra-renal cortex has been thought to prevent formation of the lipoids necessary for the development of the cerebral cortex. The under-development of the supra-renals may be caused by the squeezing of the foetus in utero, or by a primary aplasia of the genitals.

Another theory is that there is an inflammation of the cerebral vesicles in early intra-uterine life, or an infective hydrocephalus (infection spreading from the mother to the foetus), or again a meningitis. Anencephalics are usually female; the cause may be in the sex-determining chromosome, or the female brain may be less resistant to the process of inflammation and destruction.

The condition of the eyes varies considerably from complete absence to perfect conformation. Some foeti show absence of ganglion cells in the retina and of nerve fibres in the optic nerve. In one case, one eye was normal, the other was microphthalmic with a coloboma of the iris and choroid. In the position of the disc was a white mass. The optic nerve was normal in size, but contained no nerve fibres. No rods and cones were present. Retinal epithelium and choroid were normal except for the coloboma. In another case, the eyes were perfectly formed, but the optic nerve ended a little way from the eyes.

In other cases the optic nerve varied considerably; in some being represented by connective tissue only and in others being absent, and in some cases containing varying amounts of nerve elements. The retina in some cases contained no nerve elements and instead of an optic disc, a hole. In other cases the ganglion cells only were absent.

In **Caramazza's** three cases, one was accompanied by hydramnios and maternal oedema. Sex— two female and one male. The eyes were all perfectly formed and some nerve fibres and neuroglia were present in the optic nerve. In all cases nerve fibres were present in the retina, but were few in number. One case showed slight abnormality in the corneal structure and increased vascularity of the iris and choroid.

The author's opinion is that the arrest of development is after the formation of the optic vesicles, that is when the cerebral vesicles are well formed, and that it is produced by a variety of processes, which may be inflammatory or destructive.

E. E. CASS.

II.—MISCELLANEOUS

(1) **Georgariou, Pierre. (Athens).—A case of acute mycosis of the orbit. (Un cas de mycose aiguë de l'orbite).** *Arch. d'Ophtal.*, January, 1934.

(1) The case reported by **Georgariou** was a difficult one because the point of entry of the germ was obscure and because there was neither syphilis nor rheumatism to account for the symptoms. Signs of a tumour in the orbit appeared suddenly and in view of the difficulty in diagnosis there was some delay in operating. Entry to the orbit was obtained by an incision below the eyebrow. The tumour had the appearance and the feel of a chondroma. actually it turned out to be an acute fungoid new formation. The point of entry of the fungus remains obscure.

ERNEST THOMSON.

(2) **Rollet, J. (Lyon). — Motor accidents and hemeralopia. (Accidents d'automobile et hémeralopia).** *Arch. d'Ophtal.*, February, 1934.

(2) **Rollet** calls attention to the danger of hemeralopia in drivers of fast vehicles at night. He has had two cases in both of which lives were lost. Police statistics prove that accidents are more common at night than in the daytime and the author considers that every driver of a public service vehicle and every driver of any admits that the prevention of such accidents is difficult. It means nothing short of examination of every driver and he suggests that every driver of a public service vehicle and every driver of any sort of vehicle who has had an accident in dim light should be examined. The author stops short at suggesting what is to be done in the event of the driver being found to be hemeralopic.

ERNEST THOMSON.

BOOK NOTICES

Recent Advances in Ophthalmology. By SIR STEWART DUKE-ELDER. Pp. 434, with 3 plates, and 150 illustrations. Third edition. London: J. and A. Churchill. 1934. Price, 15s.

Both the publishers and scientists, especially medical men, must congratulate themselves upon the well-deserved success of the "Recent Advances Series." It was an excellent idea, and has been well carried out. The success of the volume on ophthalmology is shown by the fact that it has reached a third edition, and its future success is ensured by the wise policy of replacing old material by the latest advances in other branches of the subject.

In this edition work on the vitreous and the effects of drugs upon the eye has been brought up-to-date. Specially interesting and indicative of future therapeutic value is the significance of the discoveries by Sir Henry Dale and others on histamine, acetylcholine, etc., to ophthalmology. The chapter on intra-ocular infections introduces new facts and ideas into this much discussed topic, and is characterized by a sanity of outlook which is itself almost an innovation. The treatment of ocular neoplasms by radiant energy, the aetiology of trachoma, herpes corneae, keratoplasty, and contact glasses are sections which deserve notice; but the chief addition of importance to clinicians is the excellent chapter on the modern treatment of detachment of the retina.

The book fully maintains the high reputation which previous editions have merited, and is an indispensable addition to every ophthalmologist's library.

A Manual of Diseases of the Eye. By CHARLES H. MAY, M.D. and CLAUD WORTH, F.R.C.S. Seventh edition, extensively revised by Montague L. Hine, M.D., F.R.C.S. Pp. 485, 350 illustrations, including 25 coloured plates. London: Baillière, Tindall and Cox. 1934. Price, 15s.

That this textbook has reached its 7th edition is a testimony to its worth. It has been carefully revised by Mr. Hine, particularly the chapters on diseases of the lacrymal apparatus, glaucoma, cataract, squint and heterophoria and retinal detachment in which descriptions of recent advances and modern operative technique have been given. The practical points in the prescribing and fitting of contact glasses and the newer methods of orthoptic training are described. This book is essentially for the student and general practitioner to whom it should prove a useful clinical guide. It presents in a clear, concise and lucid manner the salient features of the more common ocular disorders, rareties receiving but brief

attention. In spite of much new matter the size of the book has been increased by 30 pages only. This has been effected by the omission of some paragraphs and sections in previous editions. Two new coloured plates have been added and many new illustrations, more in keeping with modern practice, have replaced some of those in the last edition. The illustrations are on the whole good.

Methoden zur Untersuchung der vegetativen Funktionen des Auges und der Leistungen seiner Anhangsorgane. By K. VELHAGEN, JUN. (Handbuch der biologischen Arbeitsmethoden, herausgegeben von Professor Dr. Abderhalden). Berlin and Vienna: Urban and Schwarzenberg. 1934. Price, Rm. 6.

The author describes in detail the different methods in eye operations on various animals.

In the introduction he deals with the necessity, or rather non-necessity of vivisection, since it is not only possible but inevitable to anaesthetise the animals, either generally or locally. He first enumerates the instruments necessary, and goes on later to anaesthesia. For general anaesthesia he is in favour of urethane and tincture of opium rectally.

The next chapter contains the operative methods employed, of which the description of the access to the ciliary ganglion is most important. The details have to be read in the original. The enucleation of the globe he describes as being very much the same operation as in human beings.

Going on to the more important part of his work, Velhagen describes the physiological experiments used by himself and other research workers. These experiments are mostly too complicated to be explained here, but nevertheless, are well worth reading. The same applies to the apparatus used. The whole description is very complete, and includes experiments with the isolated eye itself, with the sphincter and dilatators, as well as the muscles of the iris as a whole.

The next important chapter concerns the movements of the pupil and its cinematography, including experiments on change of eye fluids, muscles of eye and lid, function of lacrymal gland and sac.

He closes with temperature measurements of the eye and a short review on ophthalmoscopy in various animals.

Die methoden der Ophthalmographie. (Augenhintergrundphotographie). By J. W. NORDENSON. Stockholm.

Nordenson gives first a short historical description of the development of fundus photography. At the present time the apparatus used for this purpose is devised by Wertheim-Salomonsohn and by the author. Only Nordenson's camera is described. There are two

different apparatus, the monocular and the stereoscopic; the only difference being a monocular chamber in the first and a stereo-chamber in the second variation.

In constructing his camera the author follows Gullstrand's principles for the simple ophthalmoscope. A detailed description of the apparatus is given, the complicated ophthalmographic lens explained, and also particulars of usage, which is relatively simple if certain rules are observed. The manipulation of the stereoscopic camera is entirely similar to the one just mentioned.

The author also includes a short note on coloured pictures of the fundus which at present do not seem to be very satisfactory.

Nordenson also mentions without further details that Pavia does ophthalmocinematography.

Das Glaucomproblem und die Glaucomoperationen. By LEOPOLD MÜLLER. Wilh. Mandrich. Wien. 1934. Price, Rm. 6.

In a book of little more than 100 pages the author discusses his personal experience of glaucoma including aetiology, the different categories of the disease and the operative and non-operative treatment.

Of primary glaucoma he recognises two different kinds, namely, glaucoma simplex and the inflammatory or intermittent glaucoma; neither glaucoma prodromale nor glaucoma absolutum is acknowledged by Müller. Regarding aetiology he follows Leber's theory; heredity plays a big part, particularly in inflammatory glaucoma.

The main features of inflammatory glaucoma are:—(*a*) site: parasympathetic third nerve; (*b*) sudden water formation plus sudden blockage of the anterior chamber; (*c*) often hereditary; (*d*) irritability of the vegetative nerve system; (*e*) often latent; (*f*) attacks with oedema of the anterior part of the eye, as well as of oedema of the papilla with peribulbar inflammation; (*g*) real hypertension excavation; (*h*) always hypertension; (*i*) intermittent course; (*j*) sometimes spontaneous cure, also cure by means of drugs or iridectomy without drainage.

As main features of glaucoma simplex the author points out as site of the disease:—(*a*) ciliary "gland"; (*b*) continual hypersecretion, plus increased discharge of what he calls "liquor ophthalmicus," which means the liquor of the chambers plus the liquor of the vitreous body; (*c*) heredity, rare; (*d*) never latent; (*e*) no attacks; (*f*) always excavation owing to death of tissues and formation of caverns in contradistinction to the formation of an excavation in inflammatory glaucoma, which is always caused by hypertension; (*g*) hypertension may be present or absent; (*h*) cure only possible by adequate drainage for the liquor ophthalmicus.

In the second part of the book, Müller discusses operations. In this division his ideas follow more or less the usual lines. He

points out the importance of fields of vision, the opacity of the vitreous body and excavation; the result is dependent on all these. He never lets the patient use drops, either eserine or pilocarpine, continuously after the first operation, because of the possibility of missing the right time for the second operation in unhealed cases. The operations he employs for glaucoma simplex are:—cyclodialysis, which is particularly effective in cases of aphakia; and a similar operation called cyclodialysis plus depressio lentis. The main operation for glaucoma simplex is trephining with a modification concerning the incision called transcorneal trephine plus peripheral iridectomy. For inflammatory glaucoma his operation of choice is iridectomy with minor modifications.

The non-operative treatment differs in no way from that usually employed.

OBITUARY

PROFESSOR RAMON Y CAJAL

THE death of Ramon y Cajal should not pass unnoticed in an ophthalmological journal, for it was largely due to his pioneer work in the histology of the central nervous system that our knowledge of the histology of the retina is as complete as it is. Ramon y Cajal was born in 1852, the son of a doctor; he devoted the greater part of his life to histology and in due course his name became a household word far outside the borders of Spain. The most modest of men he valued the honours which came to him, not so much on his own account as that through him his native country was honoured. He was a Foreign Member of the Royal Society, Croonian Lecturer and Nobel Prizeman as well as Life Senator of Spain. His health did not allow of his meeting his ophthalmological confrères at the Congress in Madrid last year, but each member attending was presented with a beautiful little medallion of him.

PROFESSOR FRITZ ASK

WE regret to record the death in October last of Fritz Ask, of Lund, the well-known Swedish ophthalmologist. He was a member of the Editorial Board of *Acta Ophthalmologica* from its inception in 1924 and did very good work on myopia, the development of the lacrymal passages, treatment of dislocated lens and the vitreous, and intraocular pressure. He was also interested in military ophthalmology. In all he was the author of thirty-five papers and two monographs.

He became personally known to his English confrères at the International Ophthalmological Conference at the Hague in 1927, when it was decided to resume the International Congresses; and he was a member of the International Ophthalmological Council.

At the jubilee of the Ophthalmological Society in 1930 Ask represented Sweden as a delegate and in the unavoidable absence, through illness of Prof. Lundsgaard, of Copenhagen, presented addresses on behalf of the Scandinavian ophthalmologists, and made a short speech in Latin.

Cast in massive mould, Ask was one of the kindest of men. He will be much missed by his colleagues on the International Council and in his native land. He leaves a daughter to whom the sympathy of ophthalmologists all over the world will go out in her bereavement.

NOTES

Addenda

Mr. PERCIVAL HAY writes:—"Since my description of the perforated diaphragms given in the Journal for November, Messrs. Hamblin, Ltd., have made for me an alternative in the shape of perforated discs permanently fixed in position at the back of the cells of the trial frame. They have the advantage of permanent centration, and are cheaper to manufacture."

Dr. Hagedoorn sends us the following addition to his paper, "Telangiectatic Granuloma — Botryomycosis." published in the October number:—

At my request Professor Masson was so kind as to send me his important article, which, owing to the author's stay in Canada, arrived too late to be given the attention it deserves in my paper.

After a gunshot wound in the thigh, affecting the bone, fistulae developed. The fistulous cicatrix was excised and sent to Masson for histological examination. Besides other inflammatory conditions little nodules were found. These nodules contained pus, embedding two kinds of foreign bodies: small bone sequestra and botryomycotic globules. In the pus itself free staphylococci were practically absent. Masson states that the staphylococci, killed by the action of the phagocytes elsewhere, continue to grow in the Haversian canals of the bone. If gradually the bone becomes resorbed, a membrane covers the colonies; finally the globules containing the cocci are liberated, lying free in the pus. Masson following Magrou (*Thèse de Paris*, 1914), speaks of a symbiotic adaptation of the cocci to the organism-host, and considers his case as the clinical confirmation of Magrou's experiments.

Magrou injected a large dose of ordinary staphylococcus in the testicle of a guinea pig, abscesses developed; if only 1/100 of a milligram was injected the staphylococci were totally destroyed; if 1/10 of a milligram was injected evidently an equilibrium occurred and globules were formed. After Magrou this mode of reaction is also observed in other organisms (*e.g.*, Koch's bacillus).

P. Masson.—Plaie de guerre botryomycosique. *Lyon Chirurgical*, Janvier-Février, 1918.

* * * *

International Ophthalmological Congress, 1937. Cairo

A LOCAL COMMITTEE for organizing the work of the Congress at Cairo in 1937 has been formed as follows:—

Président: Le Ministre de l'Intérieur et de l'Hygiène; *Vice-Présidents:* Le Sous-Secrétaire d'Etat à l'Interiéur pour l'Hygiène publique; Le Dr. Ali Ibrahim Pacha, Doyen de la Faculté de Médicine et Recteur de l'Université Egyptienne p.i.; *Membres:* Abdel Fattah Sabry Pacha, Sous-Secrétaire d'Etat à l'Instruction publique; Ahmed Abdel Wahab Pacha, Sous-Secrétaire d'Etat aux finances; Le Dr. Ahmed Hilmy Bey, Sous-Secrétaire d'Etat, Adjoint à l'intérieur pour l'Hygiène publique; Mahmoud Chaker Mohammed Bey, Directeur général de l'Administration des Chemins de Fer, des Télégraphes et des Téléphones; Mahmoud Sidky Pacha, Gouverneur du Caire; Le Dr. Issa Hamdi El Maziny Bey, Directeur de la Section des Hôpitaux Ophtalmiques; Le Dr. Mohammed Tewfik Eff., Sous-Directeur de la Section des Hopitaux Ophtalmiques; Le Dr. Sayed Abdel Hamid Soliman Bey, Le Dr. Salem Hindawi Bey, Le Dr. Mahmoud Riad Eff., Le Dr. Mahmoud Taher Bey.

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North of England Ophthalmological Society

THE 1935 lectures which are held under the auspices of the North of England Ophthalmological Society have been arranged as follows: The lectures for 1935 will be delivered by Mr. Charles Goulden on Friday, January 18, at the General Infirmary, Leeds, at 4.30, subject "The Principles of Orthoptic Training," and on Tuesday, January 22, at the Royal Infirmary, Manchester, at 4.30, subject "Accommodation." Tea will be served half-an-hour before the lectures.

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Carl Koller

NOTES on a case of bilateral Rodent Ulcer, anent the article of Dr. E. L. Jones in the October number of the *Brit. Jl. of Ophthal.*

Dr. Carl Koller writes:—A great many years ago, perhaps 30 or 35, an elderly man with "Rodent Ulcer" (Mooren) came under my treatment. In spite of all medication usual at the time the

ulcers progressed over the whole cornea, until the whole superficial layers of both corneae had been eaten away. The superficial layers retracted towards the periphery, and the transparent part of them retracted like a flap towards the opposite place of the limbus, and looked very small indeed. The patient passed from my hands into those of the late Dr. Herman Knapp—who applied the actual cautery very thoroughly, without being able to stay the process. In desperation the man came back to me, and I had the inspiration to use tincture of iodine under the overhanging margins of the progressing ulcers. (For this proceeding, now quite commonplace, Dr. Nettleship gave me credit for having first applied tincture of iodine to the cornea; I cannot find now the reference to his remark.) The result was very gratifying indeed; for not only was the further progress checked, but the ulcers healed, and the retracted flaps of superficial transparent cornea were drawn back again, so that an almost whole clear cornea resulted on both eyes, and only a small opaque sickle-shaped scar on the sites of origin was visible. I showed the man at a meeting of the ophthalmological section of the New York Academy of Medicine. I don't know of course whether tincture of iodine would act the same in every case, for I have not seen a case of Mooren's ulcer since.

In publishing this short note we should like to remind our readers that this year sees the fiftieth anniversary of the publication of the author's work on cocaine as a local anaesthetic. Cocaine still holds the field in ophthalmic surgery, and as we published an annotation on this subject in 1928 we shall content ourselves with congratulating Dr. Carl Koller on having seen the jubilee of work which has been a blessing not only to innumerable patients but also to all ophthalmic surgeons. The discovery of cocaine ranks as one of the greatest advances in ophthalmology of the past fifty years and it is difficult for us of the present day to imagine the handicaps under which our ancestors worked without it.—EDITORS.

FUTURE ARRANGEMENTS

1934

December 4.—*Midland Ophthalmological Society*, at Birmingham Eye Hospital.

December 7.—*North of England Ophthalmological Society*, at Leeds.

December 14.—*Section of Ophthalmology, Royal Society of Medicine* (Clinical Meeting).

1935

January 11.—Section of Ophthalmology, Royal Society of Medicine.
January 18.—North of England Ophthalmological Society, Mr. Charles Goulden, at General Infirmary, Leeds.
January 22.—North of England Ophthalmological Society, Mr. Charles Goulden, at Royal Infirmary, Manchester.
February 5.—Midland Ophthalmological Society, at Worcester Ophthalmic Hospital.
February 8.—Section of Ophthalmology, Royal Society of Medicine.
February 15.—North of England Ophthalmological Society, at Newcastle-on-Tyne.
March 8.—Section of Ophthalmology, Royal Society of Medicine (Clinical Meeting).
March 15.—North of England Ophthalmological Society, at Liverpool.
April 5.—Midland Ophthalmological Society, at Nottingham Eye Infirmary.
April 12.—North of England Ophthalmological Society, at Sheffield.
May 31.—Midland Ophthalmological Society, at Bath Eye Infirmary (joint meeting with South-Western Ophthalmological Society).
June 14.—Section of Ophthalmology, Royal Society of Medicine (Annual Meeting).
October 1.—Midland Ophthalmological Society, at Birmingham Eye Hospital.
December 3.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

CONTEMPORARY OPHTHALMIC LITERATURE

American Journal of Ophthalmology. *October, 1934.*

RONES. The genesis of atypical ocular coloboma.
ADELMANN. The embryological basis of cyclopia.
WALLS. The reptilian retina.
JULIANELLE and LAMB. Studies on vascularization of the cornea.
EBER. Fistula at limbus (*scleromalacia perforans*).
PETER. Technique of electro-coagulation in the treatment of retinal detachment.
CHANCE. Conservative treatment of massive cystoid following cataract extraction.
CASTROVIEJO. Keratoplasty.
HARTSHORNE. A case of choroidal atrophy without night blindness.
LEBENSOHN. 1934—The semi-centenary of local anaesthesia.

Archives of Ophthalmology. *September, 1934.*

THYGESON. The nature of the elementary and initial bodies of trachoma.
JAFFE. Retinoblastoma: report of a case with complete observations at autopsy.
ROW. Operation to control glaucoma: preliminary report.

GJESSING. Diagnosis of diseases of the eye: value of the history and spontaneous statements of the patient.
HAMILL. Tubular vision.
COHEN, NEWELL and KILLIAN. Experimental studies on swelling of the vitreous gel and intra-ocular pressure.
SMOLEROFF and AGATSTON. Metastatic carcinoma of the retina: report of a case, with pathologic observations.
FINKLEMAN and WICK. Pressure on the optic nerve by carcinoma of the maxillary sinus extending into the cranial cavity.
JAMESON. The ligated suture.
LEBENSOHN and BELLOWS. The nature of photophobia.
ABRAHAM. Amblyopia: classification with a report of cases.

October, 1934.

KOLLER. Preliminary report on local anaesthesia of the eye.
ADLER and FLIEGELMAN. Influence of fixation on the visual acuity.
ADSON and BENEDICT. Hemangio-endothelioma of the orbit: removal through trans-cranial approach.
O'CONNOR and PIERCE. Repair and restoration of the eye socket.
LILLIE and ADSON. Unilateral central and annular scotoma produced by callus from fracture extending into optic canal: report of two cases.
LA ROCCA. Alterations of retina in experimental toxic nephrosis.
GIFFORD and DILLON. The conjunctivo-glandular syndrome of Parinaud: a report of a case showing a thread mould in sections.
RODIN and NEWELL. Movements of eyes under cover. A Roentgenographic study.
BURKY. Experimental endophthalmitis phaco-anaphylactica in rabbits.
SWAB. Ocular lesions resulting from thallium acetate poisoning.
PECKHAM. Foveal projection during ductions.
BARR. Essential (progressive) atrophy of the iris: report of a case.
COWAN. Some factors concerned in the correction of aphakia.

Archives d'Ophtalmologie. *October, 1934.*

VILLARD and DEJEAN. Ophthalmia of caterpillars.
BOLETTE. Traumatic myopia.
HERMANN. Annular abscess of the cornea.

Annales d'Oculistique. *September, 1934.*

FILATOFF. The cornea of a corpse as material for transplantation.
ARNAUD and GUILLOT. Utilization of Bailliart's test in the diagnosis of intra-cranial hypertension in recent injuries of the skull.
DODERO and CORNET. Eighteen cases of peri-ocular degeneration observed in Indo-China.
RISCHARD. Physiology of light and accommodation reflexes. The Argyll Robertson sign.
RIFAT. Primary sarcoma of the conjunctiva.
SALLENCE. Can one measure objectively lens astigmatism?
MAUGER. Mask for cataract operation.

Klinische Monatsblätter für Augenheilkunde. *September, 1934.*

SIEGRIST. In what manner can a tuberculous iridocyclitis of the cornea become sympathetically inclined?
NEUMANN. The enigma of tuberculosis. Observations and thoughts on the localization of emboli and on the psycho-neurotic "pre-tubercular condition."
HANDMANN. Multiple fine capsular epithelial clumps in the shape of insects in after-cataract.

ROHRSCHNEIDER and SPONHOLZ. A case of quiescent disseminated choroiditis with complete post-mortem result and observations on the source of the tuberculous ocular metastases.
LÖWENSTEIN. The correction of congenital and acquired lid margin defects through auricular cartilage plastic transplantation.
KLIEN-MONCREIFF. Deviation of optic nerve fibres.
RUBERT. Notes on the treatment of trachoma.
MUCH and HÜPPI. Acute optic neuritis with sudden transitory blindness as in the primary stage of an acute anterior poliomyelitis.
MUCK. Is there a neurogenous heterochromia?
HIGUCHI. Histological investigations on a case of choroidal abscess of metastatic origin with a clear ophthalmoscopic image.
SAGHER. Contribution to the question of the anterior polar cataract with crystalline infiltration as in senile cataract.
KAELIN-SULZER. Improved technique of the Vogt skeleton-free bulbous absorption. Production of an exophthalmos.
NÉMETH. Cornification of the conjunctiva of the inner canthus region.
MOTEGI and SYU. Ophthalmological observations in 101 cases of chronic opium poisoning.
SPINELLI. On the remarks of Fischer and Klein on my method of micrometry of the fundus and scleral localization for retinal holes.

October, 1934.

TRENDELENBURG. A signal light apparatus for testing colour blindness.
LÖHLEIN. Fundus ectasia on the nasal side of the superior and inferior cone.
WÖLFFLIN. A contribution to the anatomo-pathological conditions of albuminuric neuro-retinitis.
BRANA and RADNAI. The prognosis of high tension as a basis of vascular changes in the fundus.
KNAPP. Raynaud's disease?
MÜLLER. A remarkable case of bilateral corneal degeneration in a child.
KOYANAGI. The retention of the retinal pigment epithelium in eclampsia.
GIFFORD. The question of Parinaud's conjunctivitis.
MACHEMER. The processes in living tissues of the action of galvanic currents.
NOWKIRISCHKY. The treatment of old corneal opacities by Dr. Schuberg's eye ointment.
MÜGGE. Surgery of the lacrymal passage.
WANG. The statistics and pathology of scrofulous inflammation of the eyes in Shanghai.
MUCH. Observations on the question of contact glasses.
TRANTAS. The question of retinal tears without detachment of the retina.
GOLDMANN. A new objective revolver for the slit-lamp.
——— A light fixation point for the Javal ophthalmometer.
BOEHM. Emendation of my work "On the delicate structure of the lens capsule."

Annali di Ottalmologia e Clinica Oculistica. *October, 1934.*

CORRADO. The inconsistency of the relations between degrees of deviation and visual function in concomitant strabismus.
GIANNINI. Choroidal endothelioma in subjects with multiple neoplasms.
——— Bacteriological and clinical contribution to the study of corneal ulcers from the bacillus pyocyaneus.
VILLANI. Biomicroscopy of the diabetic eye.

Lettura Oftalmologica. *August, 1934.*

ALIQUO-MAZZEI. Ocular complications of Recklinghausen's disease.
MOSSA. Contribution to the study of retinitis proliferans.
SANGUINETTI. Vaccine infection of the eye.

September, 1934.

ALIQUO-MAZZEI. Congenital paralysis of the lateral movements of the eye.
PADOVANI. Endocrine secretions in cases susceptible to spring catarrh with keratoconus.
PISANI. Sulphur therapy for the eye.

October, 1934.

TREMATORE. Experimental keratitis of B.C.G.
MASI. Old and new ideas in the aetiology and treatment of trachoma.
TRISTAINO. The oculo-cardiac reflex in sufferers from progressive paralysis and tabes dorsalis.

Bollettino d'Oculistica. *August, 1934.*

GRANDI. Atypical nodular aspergillus keratomycosis.
VILLANI. Experimental study on the repair of wounds of the lids.
SALA. Ocular calcification with particular regard to the biomicroscopical aspect of copper cataract.
MOTOLESE. Ulceration of the conjunctiva with attendant polyadenitis from "streptococcus haemolyticus melanogenes."
BENCINI. Extraction of cataract in eyes already operated on for glaucoma.
ANELLI. The permeability of the lacrymal passage in dacryocystitis.
NEUSCHULER. Allergic blepharo-conjunctivitis from cosmetics.
TITA. A case of subconjunctival cysticercus.

September, 1934.

BENCINI. Edmund Jensen's retino-choroiditis.
CARAMAZZA. Biomicroscopy of the vitreous in aphakia.
BATIGNANI. Conjunctivitis of herpetic virus in the new born.
RINALDI. Local action of the sexual hormones on septic wounds of the cornea.
GALEAZZI. Clinico-statistical contribution to the study of simple astigmatism.
MOSSA. Myelosis neoplastiforme with orbital invasion and bilateral exophthalmos or histiocytomatosis?

Revista Oto-Neuro-Oftalmologica. *September, 1934.*

PAVIA. Berlin's oedema and consecutive choroido-retinal changes.
ROSENGRAN. Juvenile amaurotic idiocy. (Translation from Dr. J. L. Pavia).

Revista Oto-Neuro-Oftalmologica y de Cirurgia Neurologica.

November, 1934.

MACKENZIE. The pathogenesis of cholesteatoma.
METTEY and REDSLOB. Transudative pigmentary choroido-retinitis.
PAVIA. Diffuse sclerosis of the choroid.
ROSENGRAN. Juvenile amaurotic idiocy.
PAVIA and DUSSELDORP. Papulo-necrotic acne of the cornea and conjunctiva.